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Procedia - Social and Behavioral Sciences 199 (2015) 657 – 665

Procedia
Social and Behavioral Sciences

GlobELT: An International Conference on Teaching and Learning English as an Additional Language, Antalya - Turkey

Critical thinking within the current framework of ESP curriculum in technical universities of Russia

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Abstract

Over the last decade technical universities in the Russian Federation, the subject of English as a foreign language has been taught in such a way, where it appears separate from the main program content of engineering discipline. The text books used for language teaching contain contextually unrelated examples which demonstrate a given grammatical function applied to different imaginary situations. As a result of practicing language by means of such unrelated examples the subject of English language stands out from the rest of the subject area and viewed by many students as irrelevant. Meanwhile, in light of current state of international education and research, successful career in science and engineering requires appropriate control of English language and critical thinking. In our article we present a general overview of concepts of critical thinking and its components, its disposition in science and the humanities and provide general reflection of ESP integration in ESL and EFL.

Peer-review under responsibility of Hacettepe Üniversitesi.

*Keywords:*Critical thinking, science of learning, foreign language teaching, English for Specific Purposes, engineering

1. Introduction

Today there is international recognition that education is more than just learning knowledge and thinking, it also involves learner's feelings, beliefs and the cultural environment of the classroom. However, the importance of teaching thinking and creativity is an integral element of education in the 21st century, since emotive aspects—feelings, emotional responses, intuitions, sensing—are central to critical thinking in adult life. In particular, the

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Peer-review under responsibility of Hacettepe Üniversitesi.
doi:10.1016/j.sbspro.2015.07.595

ability to imagine alternatives to one's current ways of thinking and living is one that often entails a deliberate break with rational modes of thought in order to prompt forward leaps in creativity.

Different groups conceptualize these notions differently. The framework developed by the European Commission sees them as something that goes beyond physical and cognitive aspects to include attitudes, and assumes that these capacities are essential to assure a successful life in society. Others like the Assessment and Teaching of 21st Century Skills project encompasses attitudes. The framework was seen as having four parts: ways of working, tools for working, living in the world, and ways of thinking. Ways of thinking was conceptualized to include creativity and innovation, *critical thinking*, problem solving, and learning to learn and the development of meta-cognition. It also meant that the ways of learning, and ways of teaching, need to be taken into account in the development of the assessment strategies that focus on these skills.

Initiatives undertaken by UNESCO and OECD PISA also provided great context for the practical work on teaching curriculum and assessment of ways of thinking and working. UNESCO took the competence approach. The Delors Report in 1996 marked the beginning of UNESCO's 21st century competence learning discourse with learning to know, learning to do, learning to be, and learning to live together, forming the four basic pillars of learning. These four pillars are more complex than appears, and shift the discussion somewhat to a philosophical level. Learning to know includes developing the faculties of memory, reasoning and problem solving, and it presupposes learning to learn and could usefully be extended to the concept of knowledge building. This perspective doesn't presume that knowledge is fixed. Learning to do refers to developing an understanding of others as well as highlighting the reality that if we are to understand others, we must first know ourselves.

Each of the approaches to understanding of 21st century skills and how they fit with our notions of education and the function they serve, emphasizes skills that diverge from modern traditional notions of academic disciplines. And most of them include creativity, *critical thinking*, productivity and problem solving.

2. Concepts of critical thinking

The concept of critical thinking has been interpreted in various ways. It has been equated with the development of logical reasoning abilities (Hallet,1984; Ruggiero,1975), later with the application of reflective judgment (Kitchener, 1986), with assumption hunting (Scriven, 1996), and with the creation, use, and testing of meaning (Hullfish and Smith,1961). Ennis (1962) speaks about twelve aspects of critical thinking. They include analytical and argumentative capacities such as recognizing ambiguity in reasoning, identifying contradictions in arguments, and ascertaining the empirical soundness of generalized conclusions. D'Angelo (1995) lists ten attitudes for being critical-including curiosity, flexibility, skepticism, and honesty. O'Neill (1985) proposes the ability to distinguish bias from reason and fact from opinion- it serves the central component of critical thinking. To Halpern (1995), critical thought is a rational and purposeful attempt to use thought in moving toward a future goal.

Critical thinking is mainly conceptualized as an intellectual ability suitable for development by those involved in higher education (Drake, 1976; Young, 1980; Meyers, 1986; Stice, 1987). Empirical studies of the development of critical thinking capacities focus on young adults, (King, Kitchener, and Wood, 1995) or college students (Perry,1970, 1981). While this setting for critical thinking is undoubtedly crucial, it is but one of the many settings in which critical thinking is practiced, particularly in adult life.

One alternative interpretation of the concept of critical thinking is that of emancipatory learning. The idea derived from the work of Habermas (1979). He identifies this as one of the three domains of learning (technical and communicative learning being the other two). As interpreted by adult educators (Collins, 1985; Hart, 1985; Apps,1985), emancipatory learning is evident in learners becoming aware of the forces that have brought them to their current situations and taking action to change some aspect of these situations. To Apps (1985, p. 151), "emancipatory learning is that which frees people from personal, institutional, or environmental forces that prevent them from seeing new directions, from gaining control of their lives, their society and their world.'' A second concept closely related to that of critical thinking is dialectical thinking. Dialectical thinking is observed as a particular form of critical thinking that emphasizes the understanding and resolution of contradictions. Morgan (1986, p. 266) writes that "dialectical analysis (thus) shows us that the management of organization, of society, and of personal life ultimately involves the management of contradiction." Dialectical thinkers engage in a continual process of making judgments about aspects of their lives, identifying the general rules implicit in these judgments,

modifying the original judgments in light of the appropriateness of these general rules, and so on. Change is regarded as the fundamental reality, forms and structures are perceived as temporary, relationships are held to involve developmental transformations, and openness is welcomed.

Thinking critically involves our recognizing the assumptions underlying our beliefs and behaviors. Critical thinking, then, involves a reflective dimension. The idea of reflective learning is a third concept closely related to that of critical thinking. Boyd and Fales (1983, p. 100) define reflective learning as "the process of internally examining and exploring an issue of concern, triggered by an experience, which creates and clarifies meaning in terms of self, and which results in a changed conceptual perspective." Table 1 summarizes the target situations for critical thinking.

Table 1. Target situations for critical thinking

Appropriacy of critical thinking	Inter-related phases
Beyond the novice level	Discovering the assumptions that guide our decisions, actions and choices
After initial assimilation	
When skills/ knowledge have to be applied in the real world	Checking the accuracy of these assumptions by exploring as many different perspectives, viewpoints and sources as possible
When fit/suitability needs to be addressed	
When independent judgment is needed	Taking informed decisions that are based on these assumptions (informed decisions are based on evidence we can trust, can be explained to others and have a good chance of achieving the effects we want)
When power and hegemony are a focus of study	
When alternative interpretations and perspectives are possible	
When actions and decisions need to be informed	
When rapid judgments are called for	

3. Critical thinking in natural sciences and humanities

Both the sciences and the humanities are in search for understanding; they offer explanations, descriptions, and projections of various objects and their behavior in the world. However, at a very abstract level the type of phenomenon they try to explain is not identical. Obviously, Hamlet is a very different type of phenomenon than thermometer readings. When an English professor gives an interpretation of Hamlet, she basically has all the content to be explained in front of her. The text is complete and finished. To put the point in terms of evidence instead of explanation, all the data she can offer for her preferred interpretation of the text is already in. This stands in clear contrast with most of the sciences: new data is constantly being gathered, and new observations need to be explained, proved, repeat the experiment and receive identical results. If a similar process were occurring in the Hamlet case, a new Act of that play would be produced every week, and various interpretations were shown to be stronger or weaker as new 'data', that is texts, came streaming in.

Without a critical approach and understanding of how technologies and systems work and govern our lives, we will not be able to make rational decisions about them and their current and future impact. Obviously critical thinking skills and problem solving stand out here in their most clear nature.

However, "solving" may be regarded as a misleading descriptor. Not all thinking is problem driven. More and more, our problems come to us as dilemmas, tough irreconcilable choices: security or personal freedom, environmental protection or economic growth. It means that solving problems requires more than just developing tools to address a need. The thinking that happens before action, the crucial framing of the issues, is essential. The humanities augment the analytical thinking that is the essence of science and technology. Critical thinking framework in the humanities is about being able to contemplate and frame questions differently; creative and metaphorical thinking come into play. Questions are placed on a broader canvas, with context and an understanding of implications from the perspectives of individuals and groups.. Table 2 shows the types and frequency of dispositions of critical thinking in the humanities and sciences.

Table 2. Learning behaviors that reflect critical thinking in natural sciences and the humanities (UMass' Amerhest General Educaton Assessment Report, 2007) (see Appendix)

Skills and dispositions crucial to critical thinking	Natural sciences	Humanities
Openness to others/ suspend judgement	√	√
Judgment/ Argument	√	√
Synthesizing/ generalizing/ making connections		√
Problem solving	√	
Evidence-based thinking	√	
Drawing Inferences	√	√
Multiple Perspective/ Perspective Taking	√	√
Application	√	√
Meta cognition/ Self-reflection		√
Questioning/ Skepticism	√	
Knowledge/ Understanding	√	√
Discipline-based thinking	√	

4. Science of learning: When your students are ready

Learning readiness refers to how likely a person is to seek out knowledge and participate in behavior change. Once learning needs have been identified, the next step is to determine the learner's readiness to receive information. The peek model for readiness to learn (Bastable, 2011) has four components. P-E-E-K. P equals physical readiness. And this includes measures of ability which include fine and/or gross motor movements, sensory acuity, adequate strength, flexibility, coordination, endurance. Then the complexity of the task because it will affect the extent to which behavioral changes in the domains can be mastered by the learner. And it also comes into play when unlearning is required, or when new learning is required as well. Very complex task will naturally take more time than a very simple one. This readiness also includes environmental facts. Distraction includes noise and the frequent interruptions and the value of self- pacing.

The first E is for emotional readiness as well as the anxiety level. A certain level of anxiety does motivate people to learn, however, it does impact one's ability to concentrate and retain information.

The second E is for experiential readiness. This reflects the level of aspiration, and this is really the extent to which the learner is driven to achieve as well as their previous failures and past successes; which impact their goals. This is closely related to the issue of fear of failure and past coping mechanisms.

K stands for knowledge readiness. Present knowledge base that relates to cognitive ability and critical thinking in particular. It shows how much the learner already knows about a topic, or how proficient he or she is at performing a task, as s well as his or her perception of how proficient he or she is. This is also the extent to which information can be processed by the learner. All these variables are to be thought about when evaluating learners to enhance their readiness and their motivation to learn. In Table 3 we can observe the delivery of critical thinking components in the P-E-E-K Model.

Table 3. The P-E-E-K Model as seen for application of critical thinking (CT)

P- Physical Readiness	E-Emotional Readiness	E- Experiential Readiness	K-Knowledge Readiness
Measures of ability	Anxiety level	Level of aspiration (CT)	Present knowledge base (CT)
Complexity of task (CT)	Support system	Past coping mechanisms	Cognitive ability (CT)
Environmental effects	Motivation	Cultural background (CT)	

Gender	Risk-taking behavior (CT)	Locus of control	Learning disabilities
	Frame of mind (CT)	Orientation (CT)	Learning styles
	Developmental stage (CT)		

5. Foreign language teaching and critical thinking

Currently there is some disagreement as to whether language forms one's process of thought or thought guides one's linguistic development, however, all agree that there is an interaction between language and thought (Bowerman& Levinson,2001; Chomsky,1975; Vygotsky,1978; Whorf,1956). It is obvious that language and thought are interrelated, so educators must inevitably train students to develop their linguistic and cognitive skills by comparing and contrasting the target language with their own language, hypothesizing the grammatical rules of the target language, and reflecting on content based on their personal experiences and knowledge from other areas of studies.

Benjamin Bloom's (1956) taxonomy first emphasized critical thinking (Duron, et al., 2006) and brought our attention to the two levels of cognitive development. The first one consists of knowledge, comprehension, and application. These are called –low order thinking skills or LOTS. The second level, high order thinking skills or HOTS consists of the skills to analyze, synthesize, and evaluate, is regarded as more complex cognitive ability and includes critical thinking. (Duron, et al., 2006; Savich, 2008). However, even though critical thinking has been valued in various disciplines, and assessments to evaluate critical thinking skills have also developed (ex. California Critical Thinking Skills Test (Facione, 2000), the dispositions and types of activities offered to students are not discipline-specified and as Table 4 shows they generally fall in the domain of the humanities or are interdisciplinary. Another truth is that colleges and universities do not teach these skills explicitly, hoping that learners will pick them up in several years, through a series of levels, with LOTS starting the cycle of learning.

Table 4. Typical language and thinking in tasks

Bloom's taxonomy (HOTS)	Tasks
Knowledge/ remembering	
Understanding	To predict what will happen
Application	To describe (record) what they observe
Analyzing	To find patterns, notice similarities and differences
Evaluating	To compare results and draw conclusions
Synthesis/ Creating	

However, some researchers reported crucial information with regards to the development of critical thinking skills. Children in early adolescence start developing the cognitive ability to think abstract ideas and provide reasons deductively (Inhelder& Piaget,1958). However, Cotter and Tally (2009) indicate that even college-aged students might not completely develop their abstract thinking and deductive reasoning skills, which are the fundamental skills of critical thinking.

6. Content of language teaching (ESP) and critical thinking

ESP is essentially a training operation which seeks to provide learners with a restricted competence to enable them to cope with certain clearly defined tasks. These tasks continue the specific purposes which ESP course is designed to meet. The course, therefore, makes direct reference to eventual aims. GPE, on the other hand, is essentially an educational operation which will seek to provide learners with a general capacity to enable them to cope with undefined eventualities in the future. Engineering courses, however, rely on design consistency of taught theoretical and practical disciplines in terms of subject interrelations and hierarchy of skill acquisition. The level of

proficiency within subject area is obtained following logical course structure with increasing difficulty and corresponding level of detail. Thus, subjects of study, interrelation between them and logical order in which these subjects are studied jointly represent a certain academic volume bound together by common content. When choosing the course of study, students often rely on course transparency. Therefore, taking into account volume and content parameters at course design stage, where the end skill acquired by the student is made visible from the outlined progress of study becomes crucial. Visibility of the course structure ensures that students are aware of their relative progress towards the skill before and during the course. In order to maintain course coherence and fit the hierarchy of the academic volume, the content and structure of foreign language subject must comply with and relate to the volume parameters in an obvious logical manner. Hence, the language content and logical structure used for practicing certain grammatical functions are required to have a direct relation to the content and logical structure of the academic volume. The relevance of language subject content to the governing engineering discipline within language programs at technical universities currently taught (ex. Touchstone @ NUST "MISiS") is primarily based on teaching scientific terminology, vocabulary, collocations, typical phrases and applicable grammatical structures. Such focusing of the language aspect of engineering academic volume results in training student's memory and concentrates on ability to voice ideas, processes and concepts through reassembling learnt vocabulary for a given purpose according the examples from teaching materials. This is rather different from the skill of communication, which, apart from vocabulary requires the knowledge of contextual logical order and follows a certain description sequence. The skill of communication, or ability to introduce ideas and concepts to individuals making it common knowledge among them, requires such control of language, where the one communicating is able to analyze and describe matter under view to an appropriate level of detail and reconstruct or reassemble it into a coherent structure through the use of linguistic tools, visual aids and so on. Prior to attempting to learn such a skill in a foreign language it must be understood and practiced in native language to a satisfactory level. The means of studying the skill of communication include academic literature. The process of communication by means of academic literature has a certain order and logic, which is accepted as a standard by scientific community. Appropriate communication of scientific information relies on ability to make definite, conclusive and final decisions with regards to the matter in view. In other words, it depends on critical thinking. Consequently, understanding the content of subject matter is crucial, where linguistic tools are used for clear wording of all constituent parts and assembling them for communication for a given target audience accordingly through the use of corresponding grammatical structures. Clear and accurate wording and description allows the reader to think up or engineer, and implement corresponding objects and processes in the future. Hence, it is clear that linguistic contribution for an engineering course must not only include scientific terminology, relevant vocabulary and grammatical constructions, but the academic volume parameters, which include content and logic of description sequence, as well.

7. Conclusion

The article is an attempt to bring attention to the matter of critical thinking aspect of teaching English as a foreign language in technical universities of Russia. Initial analysis indicates that critical thinking has a number of aspects. The current methods used for teaching critical thinking within the framework of English for Specific Purposes teaching tend result in the ability to manipulate linguistic content to fit the text examples describing the cases, where demonstration critical thinking is worded according to the learners' language proficiency. The skill of critical thinking, or ability to make conclusive decisions within given situation, requires appropriate knowledge of content of the matter in view, which shows the need to align ESP content with the content of the main engineering discipline that together will represent a cohesive academic volume. Consequently, critical thinking requires practice in both native and foreign languages, where the latter can be viewed as an extension of a single skill of critical thinking. Such approach requires further study and a thorough review of the ESP course design methods, which, as authors propose, should diverge from generalization and move closer towards the content of the disciplines in which ESP is taught.

Appendix A. Learning behaviors that reflect critical thinking in natural sciences and the humanities

Skills and dispositions crucial to critical thinking	
Openness to others	Suspend judgment
Judgement/ Argument	Understand a range of options- compare and contrast them, make judgments about them
	Look at data, analyze it, make an argument about it
	Formulate clear, organized, logical arguments
	Get past opinion and move to judgement
	Go beyond feelings
	Use information/ provide interpretation (writing assignments/ experiments)
	Learn how to draw conclusions that are consistent on evidence
	Argue a point of view
Synthesizing/ generalizing/ making connections	Understand a range of options- compare and contrast them, make judgements about them
	Synthesize knowledge and apply to knew situations
	Compare scientific data with common sense data
	Synthesize multiple sources
	Evaluate their own experiences relative to others' views, connecting individual views with those of others (a synthesis in writing)
	Develop generalization through case-based learning
Problem Solving	Appreciate/ see different ways to approach/ solve a problem (develop new problem-solving strategies)
	Solve problems using analytical approach (for quantitative calculations and qualitative data)
Evidence-Based Thinking	Use evidence to evaluate a hypothesis and change or support it on the basis of data
	Evaluate sources of information
	Compare/ evaluate alternatives
Drawing Inferences	Draw logical conclusions from given data
	Draw inferences from texts

Multiple Perspectives/ Perspective Taking	Grapple with multiple points of view
	Take the perspective of someone different of themselves
	See multiple ways, variety of approaches, create safe zones to see differences
	Consider different points of view in evaluating background knowledge (individual research, critical reading, brainstorming)
	Suspend their beliefs
	Understand the perspectives of others
	Work critically with ambiguity and a multiplicity of perspectives
Application	Synthesize knowledge and apply to new situations
	Compare scientific data with common sense data
	Take information to class and apply it to the real world
	Apply basic concepts to their own experience
	Apply what they have learned to a new situation or change in circumstances
	Evaluate their own experiences relative to other's views, connecting individual views with those of others(a synthesis in writing)
	Make connections between individual experiences and new material or situations
	Write on personal examples and compare to assignments
	Transfer: analyze a new situation
Mate Cognition	Use the course to pursue own interests, discover what they are interested in in (self-initiated learning)
	Assess and evaluate/ question their beliefs
	Move from passive consumers to active creators of their own thinking (from analyses)
	Develop personal definitions
	Practice both learning and unlearning
Questioning/ Skepticism	Raise pertinent questions- understand issues and processes in data
	Question the truth, challenge newsy bits, how much is misinformation?
	General new questions
	Have a questioning mind, skeptical attitude
Knowledge/Understanding	Understand an argument (read and understand)
	Read and understand what they read
	Explain simple and complex phenomena in their own words as evidence of understanding

Discipline-Based Thinking	Think experimentally, device experiments/ understand how to think scientifically, test hypothesis

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